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International Specialists in the Environment

REFERENCE 25
 SITE NAME Alton Muni. L.F.
 SITE ID ILD980497614

M E M O R A N D U M

EPA Region 5 Records Ctr.



288690

DATE: October 30, 1986
 TO: File
 FROM: Kelly Walker *KW*
 SUBJECT: Illinois/R05-8410-01G/IL0335
 Alton/Alton Municipal Landfill
 ILD980497614

Solubility studies by laboratory extraction or leaching procedures are presently regarded to be the best available approach for assessing the potential environmental impact of leachates from coal solid wastes (Attachment A, P. 20).

Probably the single most important factor affecting the solubility of the accessory elements in coal solid waste is pH. Heavy metals contained in solid wastes disposed of in acidic strip or underground mines, are potentially more soluble than metals in wastes disposed under neutral or alkaline conditions (Attachment B, P. 25).

Chemical analysis utilizing the long-term equilibrium procedure demonstrates that acidic conditions result in the leaching of metals, including cadmium and nickel (Attachment A, P. 26, Table 9). As seen in this table, there is a general increase in metal solubilities as pH approaches 2.

Instrument readings for Alton Municipal Landfill at monitoring well GW103 indicate an acidic pH of 4 (Attachment C). This site was formerly the Alton Brick Company, which operated a sub-surface coal mine (Attachment D). In addition, monitoring well GW103 is screened through coal present at the site (Attachment E) which is the Colchester (No. 2) Coal Seam (Attachment F). The Colchester (No. 2) Coal Member in Illinois is a sphalerite-bearing member, thus naturally rich in zinc and cadmium (Attachment G).

Due to the presence of Colchester (No. 2) coal and the acidic condition that exists, it can be expected to detect high concentrations of metals at this site. Therefore the metals cadmium and nickel detected in the sample analysis cannot be attributed to the waste disposal practices of this site.

Kw: mh



GEOCHEMICAL PROPERTIES OF
AND THE TOXICOLOGICAL
ON AQUATIC LIFE

W.R. Roy, T.M. Skelly, I.G. Krapac, R.A. Griffin,
D.R. Dickerson, R.M. Schuller, J.J. Suloway, N.F. Shimp

and Ni. Chromium levels of this magnitude (1531 mg/kg) are generally not associated with solid wastes from coal utilization (Wewerka et al., 1976; Griffin et al., 1980; Roy et al., 1981). The observed Cr concentration may have been an artifact of the gasification process.

AQUEOUS SOLUBILITY OF THE SOLID WASTES

W. R. Roy, I. G. Krapac, and R. M. Schuller

Solubility studies by laboratory extraction or leaching procedures are currently considered the best available approach for assessing the potential environmental impact of leachates from solid wastes. At present, there are more than 50 different extraction methods cited in the literature, although many are essentially variations of the "shake-test." Some procedures were designed to simulate a particular disposal scenario and may not apply to more than one type of waste or technique for its disposal.

It would be expeditious if one extraction procedure could be developed to represent all possible disposal systems and waste materials. At present there is no universally accepted procedure. Moreover, such a universal procedure may be an unrealistic expectation.

One objective of this investigation was to generate aqueous extracts from selected coal utilization wastes using five extraction procedures that are most widely used by the scientific community or have been previously studied by the authors. The five extraction procedures that were used with each of the seven wastes included (1) the American Society for Testing and Materials Method-A (ASTM-A), (2) the ASTM-B method, (3) the U.S. EPA Extraction Procedure (EP), (4) a carbonic acid extraction procedure (CAP), and (5) a long-term equilibration procedure (LTE). Also, a large-volume generation (LVG) procedure was developed for the chronic bioassays.

ASTM-A and ASTM-B

The methods developed by the American Society for Testing and Materials (1979) are the Method-A (water shake extraction) and Method-B (acid shake extraction). These procedures involve (1) the shaking of a known weight of waste with either water of a specified composition or an acidic buffer solution, and (2) the separation of the aqueous phase for analysis. Both were designed to quickly obtain a solution for evaluating extractable materials from wastes.

The ASTM procedures recommend using the waste materials in the physical form in which they were disposed. For the seven wastes currently being studied, this recommendation was found to be impractical. The extreme variability of particle size (clay to boulder) would have made effective

subsampling impossible. Thus, the samples were air dried and ground to pass a 9.53-mm (3/8-inch) standard sieve.

The ASTM-A procedure used is a short-term shake test and involved shaking a slurry composed of 700 ± 1 g of waste with a volume of distilled-deionized water equal to four times the weight of the sample. The slurries were formed in one-gallon, wide-mouth glass bottles and sealed with Teflon-lined plastic lids. Great effort was taken to avoid contact between the slurries and any surface that might cause sample contamination. Use of the Teflon liners prevented leaching of plastisizers from the plastic lids, which could have interfered with organic analysis of the samples. The slurries were shaken for 48 hours at 100 strokes per minute using a large capacity reciprocal shaker; then they were allowed to settle for one hour. Immediately after the bottles were opened, pH, oxidation-reduction potential (Eh), specific conductance, and alkalinity measurements were made. Next, the slurries were filtered through Whatman^R Qualitative I filter paper, followed by filtering through Millipore 0.45- μ m pore size, cellulose acetate membrane filters. Subsamples were taken for cation, anion, and organic characterization.

The ASTM-B procedure was conducted identically to the ASTM-A procedure; however, a sodium acetate-acetic acid buffer solution (pH 3.5 ± 0.1) was the extraction media.

U.S. EPA Extraction Procedure

The EP was also intended to serve as a quick test for identifying wastes that are potential pollution hazards (U.S. EPA, 1980). The EP required grinding the solid sample to pass through a 9.53-mm (3/8-inch) standard sieve. Wide-mouth, one-gallon glass bottles with Teflon-lined lids, identical to those for the ASTM procedures, were used for the EP. Also, the samples were shaken at the same rate using the same shaker. A total of 200 g of solid waste and 3200 mL of distilled water were placed in the gallon bottles and shaken for 24 hours ± 0.5 hour. During the 24-hour period, the slurries were periodically removed from the shaker and pH adjusted to 5.0 ± 0.1 pH units with 0.5 N acetic acid. The pH was adjusted at 15-, 30-, and 60-minute intervals, with advancement to the next longest interval when the change in pH did not exceed 0.5 pH units. Adjustment continued for a total of 6 hours.

After the 24-hour period, the pH of the slurry was between 4.9 to 5.2. The total volume of acid added for pH adjustment could not exceed 4 mL per gram of solid waste. Adjustment was stopped when this volume was exceeded. At the end of the extraction period, the liquid and solid phases were separated. The volume of the liquid phase was then adjusted with distilled water so that its volume was 20 times that occupied by a quantity of water at 4°C, equal in weight to the initial solid sample. Sample filtration and preparation procedures were identical to those used for the ASTM methods.

Carbonic Acid Procedure

The last short-term shake procedure was a carbonic acid procedure (CAP). This method involved shaking 700 g of sample with 2800 mL of deionized water that had been purged with CO₂ gas. The CO₂-saturated water had a pH of 4.1. The extract was shaken for 48 hours, in a procedure similar to the ASTM methods.

The rationale for using CO₂-saturated water as an extractant was to simulate the solubilization of the waste in contact with soil solutions. Soils often contain higher partial pressures of CO₂ than the atmosphere above the soil, due to the aerobic metabolism of microorganisms and the decay of soil organic matter. Also, carbonic acid was used as an acidic extract since carbonic acid itself was not toxic to the organisms used in the bioassays. It would have been difficult to assess the biological toxicity of the extracts due to solutes if the aqueous medium was also toxic as was the sodium acetate used in ASTM-B.

Long-Term Equilibration Procedure

The long-term equilibration procedure (LTE) used in this study was developed by Griffin et al. (1980) for samples of coal solid wastes. A variation of this procedure was also used by Suloway et al. (1983) for coal fly ash samples. This procedure involved mixing 1700 g of sample with 17 L of deionized water in a 19-L reaction vessel made of Pyrex glass.

These mixtures were stirred for 30 minutes, twice a week, for 20 to 21 weeks in order to (as a first approximation) simulate slurry ponding environments. However, this extraction procedure is more specifically oriented toward generating a solution at chemical equilibrium with the solid wastes. This was done to produce a solution that may approximate the aqueous chemistry of pond effluent or leachate in settings where conditions of metastable chemical equilibrium develop. Samples of the extracts were periodically taken and analyzed over the 21 weeks to monitor the changes in chemical composition of the solutions.

Large-Volume Generation Procedure

A large-volume generation procedure (LVG) was designed to produce the large amount of acidic leachate that was initially anticipated for the chronic bioassays. Two 5678-L (1500 gal) Agro^R tanks were each filled with about 4.5 tons of coal refuse (fig. 3). Refuse from the OBG and WSNB sites was used in the LVG procedure. The selection of these two sites as source wastes was influenced by several factors including age, acute toxicity of extracts, and accessibility of large amounts of the material.

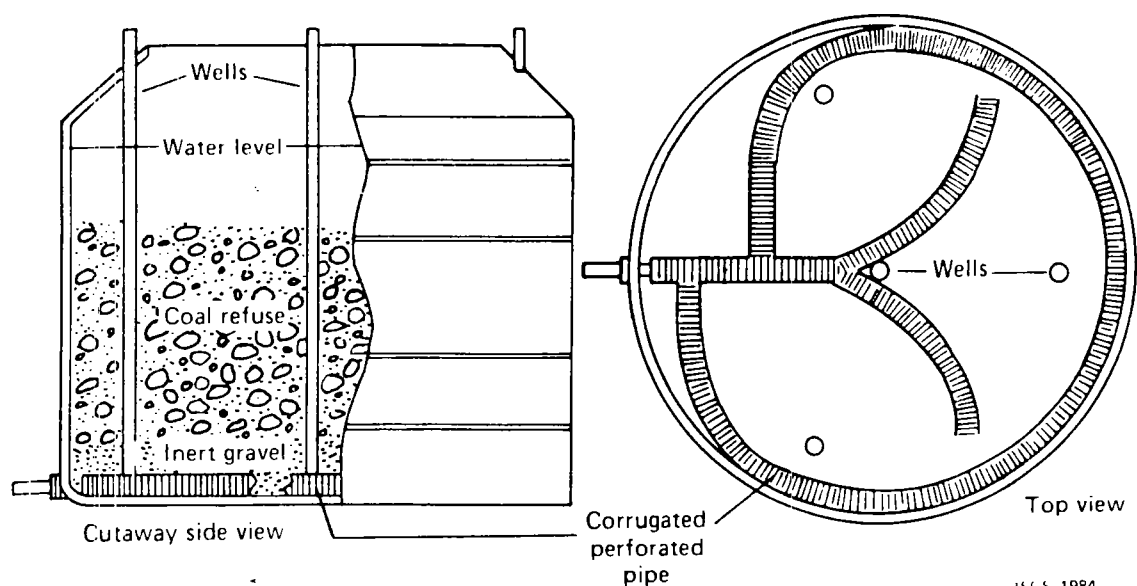


Figure 3
Cutaway side and top view of an Agro^R tank set up to generate a large volume of coal waste leachate.

A drainage system constructed of plastic corrugated and perforated pipe was installed in each tank (fig. 3), and four monitoring wells were evenly placed in each tank. The bottom of the tanks were each lined with chert gravel (the Meramac Gravel, a Mississippian-age gravel of relatively inert chemical composition) to ensure that the drainage system would remain permeable. Then each tank was filled with 6.53 kL (725 gal) of deionized water, completely saturating the solid waste (fig. 3). At the bottom of each tank a pump was connected to an outlet that was fed by the drainage system. The leachate was pumped at a rate of 454 L/hr (120 gal/hr) for 6 to 7 hours twice a week. The solution was recycled through the waste for 31 to 36 weeks, forming acidic leachates.¹

The leachate was pumped through polyethylene tubing to a discharge point at the top of each tank, below the surface of the leachate. Samples of the leachate were periodically collected from the bottom drain, the surface of the solution, and the four monitoring wells to assess the compositional variability within the tanks.

¹By definition, solutions formed by shake procedures such as the ASTM-A and EF are extracts and not leachates, although the terms extracts and leachates are often used synonymously in the literature. Since the liquid phase was passed through the wastes in the LVGs, the acidic effluent was considered a true leachate.

Results

Representative subsamples from the seven wastes were used in the generation of extracts by the four short-term shake procedures (ASTM-A, ASTM-B, CAP, EP) and the LTE procedure. The results of the short-term extractions, long-term equilibrations, and the two large volume applications are given in Appendix A.

Although it is beyond the scope of this project, the triplicate data (not shown) for each waste for each of the short-term shake procedures did give some indication of the reproducibility of the methods. The limited amount of data does not permit statistical analysis and also, the reproducibility of the analytical methods used for each aqueous constituent would have to be evaluated and taken into account. In most cases, however, either the ranges of the triplicates fell within one standard deviation of the mean, or the means could be regarded as accurate to about 10 percent, depending on the constituent and analytical concentration.

There have been several studies aimed at evaluating the nature of extraction methods (Löwenbach, 1978). Gullledge and Webster (1979) analyzed the precision and reproducibility of the ASTM-A, the ASTM-B, and the U.S. EPA's TEP or toxicant extraction procedure. Epler et al. (1980) conducted an evaluation of the EP using a wide variety of waste materials. Studies by Cox et al. (1977) and Chu et al. (1976) indicated that small-scale laboratory shake tests could not accurately simulate the field leaching characteristics of coal storage piles. Davis et al. (1981) further supported this conclusion for both short-term shake tests and column leaching methods. They further suggested that the data collected from laboratory procedures would have to be normalized with relation to the size of the storage pile and the duration and intensity of rainfall events before the in-situ leachate quality could be predicted from the laboratory results. On the other hand, Wewerka et al. (1978) concluded that the initial results from column leaching studies using coal refuse from the Illinois Basin were very representative of in-situ leachates. This comparison was made with data from another study (Martin, 1974), however, not with leachates from the same piles from which the extracted material was collected. Further study of laboratory extraction procedures and their relationship to in-situ leachates is needed.

It is difficult to generalize solubility trends from evaluating the short-term procedures in this study. Differences in the amount solute per gram of sample by each waste may stem principally from differences in pH and dissolution kinetics. It is not unreasonable to expect that solution concentrations will increase with decreasing pH where many aqueous metal ions are stable in solution and where the solid sample may dissolve. Thus, the acidic extractions such as EP (pH 5.0), CAP (pH 4.1), and ASTM-B (pH 3.1) would be expected to progressively extract more (depending on final pH) than the non-acidic ASTM-A procedure. The

Table 8. Soluble constituents: range in pH and percent extracted from four types of solid wastes, using four short-term procedures.

	Coal cleaning refuse (WSNG, WSOG, OBG)	Mine spoil (DMNS, DMOS)	Slurry (WSSL)	KilnGas (KG)
pH	1.62- 4.27	5.07- 7.57	2.43- 3.88	5.00- 8.10
<u>Extracted (%)</u>				
Al	0.08- 3.7	- ¹	0.6 - 1.20	- ¹
Ca	22.4 -80.0	1.6 -21.2	31.6 -38.4	1.2 - 4.4
Fe	0.04-28.0	- ¹	10.8 -19.2	- ¹
Mg	22.0 -52.4	23.2 -70.0	42.0 -52.4	7.2 -84.0
Mn	10.7 -23.5	0.8 -28.2	36.0 -52.4	1.76- 6.64
Ni	9.2 -24.9	0.4 - 7.2	36.3 -52.2	4.72-12.0
SO ₄	2.6 -31.3	6.92- 8.75	8.14-18.7	5.58- 9.45
Zn	2.7-28.0	0.4 - 6.0	44.0 -53.2	0.32- 8.0

¹all or most of the analytical concentrations were below detection limits.

ranges in pH and the percent extracted for selected elements for each of the four types of wastes by the four short-term procedures are presented in table 8. Magnesium appears to be the only constituent that was essentially soluble in all seven wastes by all four short-term procedures. The slurry sample released substantial amounts (greater than 35% of the matrix concentration) of Mn, Ni, and Zn independent of the extraction procedure. These anomalously high solubilities warrant further study.

Unlike the short-term extracts, the long-term equilibrates (LTEs) permitted the study of changes in chemical composition with time. These LTEs were carried out for 20 to 21 weeks, at which time the experiments were terminated and the resulting extracts used in the toxicity characterizations. During the extraction interval, subsamples were periodically taken to monitor the chemical status of the solutions. The composition of the LTEs when the experiments were terminated is given in table 9.

The pHs of the slurry and refuse samples were acidic presumably as a result of soluble Al salts, exchangeable Al, and the oxidation of sulfide minerals; whereas KilnGas samples generated an alkaline solution. The pH of many fly-ash water systems is alkaline and has been attributed to the hydrolysis of matrix oxides (Talbot, Anderson, and Adren, 1978; Shannon and Fine, 1974; Elseewi, Page, and Grimm, 1980).

Table 9. Chemical analysis of the long-term equilibrates (LTEs) after 147 days of equilibration (concentrations in mg/L).

	WSNG	WSOG	OBG	WSSL	DMNS	DMOS	KG
pH	2.66	1.92	3.27	2.24	7.56	7.77	9.02
Eh (mv) ¹	+686	+695	+797	+855	+545	+536	+446
EC (dSm ⁻¹)	3.4	10.9	2.2	4.6	0.8	0.57	0.6
Al	41.9	69.8	64.5	27.4	<0.07	<0.07	<0.07
As	0.57	Si ²	<0.14	0.58	<0.07	<0.07	<0.07
Ba	<0.001	0.006	0.004	<0.01	0.02	0.04	0.004
Be	0.03	0.01	0.006	0.02	<0.01	<0.01	<0.01
Ca	262	123	458	60.4	144	67.0	40.8
Cd	0.48	1.26	0.02	0.64	<0.01	<0.01	<0.01
Cl	6.5	2.90	15.8	<1.0	2.1	4.1	3.6
Cr	0.09	0.10	<0.02	<0.02	<0.02	<0.02	<0.02
Cu	0.03	0.51	0.01	0.58	<0.01	<0.01	<0.01
F	-	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Fe	623	2552	0.21	971	<0.05	<0.05	<0.05
K	7.21	52.7	0.44	0.60	6.30	2.59	4.48
Mg	49.8	3.26	25.3	32.5	25.5	21.5	40.8
Mn	4.73	<0.05	2.35	6.42	0.15	<0.01	<0.01
Mo	<0.02	<0.02	<0.02	<0.02	<0.02	0.05	0.12
Na	<0.55	<0.55	3.60	<0.94	3.94	5.53	4.00
Ni	1.95	0.34	0.22	0.91	<0.05	<0.05	<0.05
Pb	<0.01	1.67	<0.01	0.01	<0.01	<0.01	<0.01
Sb	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Se	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	0.06
Si	143	103.1	51.2	55.2	3.45	7.25	7.06
Sn	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
SO ₄	3042	8721	1383	3001	427	245	314
V	<0.02	<0.08	<0.06	<0.08	<0.06	<0.06	<0.06
Zn	5.43	Si ²	4.59	2.99	0.33	0.11	0.42

¹relative to a normal hydrogen electrode.

²concentration could not be determined due to spectral interferences (see Appendix B).

Roy and Griffin (1984)¹ incorporated this conclusion into a qualitative model of fly ash-water interactions that accounted for changes in solution chemistry as a function of time. Analogous investigations with coal conversion wastes are lacking.

The pHs of the LTE extracts of the seven wastes (fig. 4) were essentially constant after two weeks of equilibration. However, pH may not be a conclusive parameter to evaluate the development of chemical equilibrium or a meta-stable equilibrium in aqueous systems. The concentrations of iron in the four acidic extracts (OBG, WSNG, WSOG, and WSSL) varied to a greater extent than the corresponding pHs (fig. 5). Solution Fe was still increasing in the LTE extract of WSSL after 20 weeks. Sulfate concentrations (fig. 6) appeared to reach steady state conditions after about a week in the alkaline solutions, but continued

Table 10. Total organic-carbon content (mg/L) of generated leachates.

Sample	Method				
	ASTM-A ¹	ASTM-B ²	CAP ¹	EP ¹	LTE ¹
WSOG	4.42	2717	20.59	136.0	4.73
WSNG	4.43	2837	7.19	1.05	1.08
OBG	2.42	2685	2.18	1.16	0.78
WSSL	34.25	2838	6.63	202.0	1.41
DMOS	13.1	2802	5.34	-- ³	3.17
DMNS	0.87	2821	1.12	-- ³	1.76
KG	-0.45 ³	2767	0.17	43.0	1.17
Blank	3.95	2841	1.81	2.24	

¹values corrected for blank.

²values not corrected for blank.

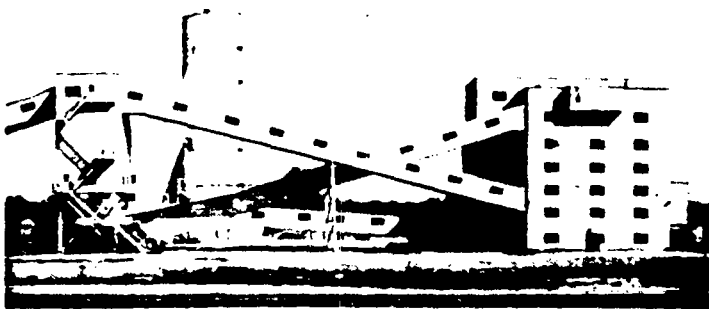
³value for sample less than blank.

to increase in the acidic systems until reaching steady state conditions after about 11 weeks. Aluminum concentrations became essentially invariant in the WSOG and OBG extracts after about 10 weeks (fig. 7); but aluminum continued to go into solution in the LTE extracts of WSNG and WSSL throughout the extraction interval. The amount of solution silicon in the WSNG and WSSL extracts (fig. 8) paralleled aluminum in that the silicon concentrations had not reached invariant levels but were steadily increasing. In contrast, the amount of soluble silicon in the alkaline samples decreased with time even though the pHs of these solutions remained alkaline. A plot of electrical conductance as a function of time (fig. 9) indicated that the acidic systems (OBG, WSOG, WSSL, and WSNG) had not reached equilibrium after 21 weeks; whereas the alkaline systems appeared to have reached steady state conditions with respect to the ionic composition of the solutions.

ORGANIC CHARACTERIZATION OF THE SOLID WASTES AND LABORATORY EXTRACTS

D. R. Dickerson and R. A. Griffin

The total organic carbon (TOC) content of the laboratory extracts generated by the ASTM-A, ASTM-B, carbonic acid procedure (CAP), U.S. EPA Extraction Procedure (EP), and long-term equilibration (LTE) was determined for each of the seven solid wastes (table 10). The extracts generated by the ASTM-A and LTE methods presented no particular problem for routine TOC analysis.



CHEMICAL AND BIOLOGICAL CHARACTERIZATION OF LEACHATES FROM COAL SOLID WASTES

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ENVIRONMENTAL GEOLOGY NOTES 89
November 1980

Illinois Institute of Natural Resources
STATE GEOLOGICAL SURVEY DIVISION, CHAMPAIGN
Jack A. Simon, Chief



SECTION 6

AQUEOUS SOLUBILITY OF COAL SOLID WASTES

Leaching experiments have long been used to determine the soluble constituents of waste materials; however, research has only recently begun to focus on the importance of the vast array of variables inherent in these techniques (Ham et al., 1978; Wewerka et al., 1978). Three principal variables influence the design of a leaching experiment: (1) the duration of the leaching period; (2) the type of system to use—static or flowthrough; and (3) which experimental parameters will be set—e.g. temperature, pH, aerobic or anerobic. Because of the number of variables, the leaching experiment can be designed to suit the field situation that the investigator wishes to simulate.

A short shake test, which the U.S. EPA recommends for algal and static bioassays (1977), will put only the readily soluble salts into solution. A long-term test (over several months) would be more likely to allow equilibrium conditions to develop. Similarly, a long-term batch reactor test would permit the equilibration of large volumes of leachate. A column study, however, would allow for a more complete investigation of the rates of constituent solubility under the more variable conditions that would occur in a field situation. For example, the column test can be designed to study the different flow rates and volumes, along with the wetting and drying that simulates rainfall.

A variety of experimental parameters exist; the parameters chosen depend upon the field conditions to be simulated. These parameters include the size of the solid waste particles, the type of atmosphere (aerobic vs. anerobic) in which the system will be kept, the temperature of the leaching system, the method of agitation, and the use of a natural vs. adjusted pH for the system.

To determine the soluble constituents of the eleven coal solid wastes, large-volume, static leaching tests were used. This involved making 10 percent (weight to volume) slurries of solid waste and distilled water in 2½- and 5-gallon glass carboys. The subsequent bioassay and attenuation studies to be conducted with the leachates necessitated large volumes of leachate and rapid attainment of equilibrium. To attain equilibrium rapidly, the wastes were initially ground to pass through a 28-mesh sieve. This insured uniformity among the wastes, which in turn promoted a more rapid equilibrium than if larger sized particles were employed. The 10 percent slurry simulated a ponding type of disposal; it also facilitated attaining equilibrium conditions more rapidly than if higher percentage slurries were made, and made it easier to stir the large volumes of heavy slurries.

Duplicate series of four slurries were made for each solid waste. One slurry from each set was allowed to equilibrate to its natural pH, while the other three slurries in the set were adjusted by adding either nitric acid or sodium hydroxide to pH values over the range of 2 to 12. Over a period of 3 to 6 months, the slurries were stirred daily and their pH monitored or readjusted when necessary to a specified value. When a constant pH was attained, it was assumed that chemical equilibrium had been reached. Preliminary studies conducted with the Lurgi ashes indicated that over 90 percent equilibrium was attained within one week.

Out of the two sets of slurries for each waste, one was equilibrated under an argon (oxygen- and CO₂-free) atmosphere, and the other under an air atmosphere.

Probably the single most important factor affecting the solubility of the accessory elements in the coal solid wastes is pH. Many coal wastes contain sulfide minerals that can acidify upon exposure to air. Heavy metals contained in solid wastes disposed of in acidic strip or underground mines, are potentially more soluble than metals in wastes disposed of under neutral or alkaline conditions. To study the effect of pH on leaching of constituents from the wastes, it was desirable to maintain a range of pH levels in the slurries.

The oxidation-reduction potential (Eh) is also an important factor affecting the solubility of minerals (Garrels and Christ, 1965). When solid wastes are buried underground or in water-saturated materials, anaerobic (oxygen-deficient) conditions usually develop. Studies of the effects of Eh and pH on the solubilities of coal solid wastes could produce data that would allow the prediction of potential pollution hazards or, on the other hand, could predict which conditions would be optimum for extraction of the potentially valuable elements in the wastes.

RESULTS OF SOLUBILITY ANALYSIS

The supernatant solutions (leachates) from the equilibrated slurries were analyzed for 43 constituents. These concentrations plus the solid ash chemical characterizations are given in tables 7 through 17. Any values given with a less-than symbol (<) represent concentrations that could not be detected by the technique used for the analysis.

Several generalizations can be made about the soluble constituents generated from the solid wastes. As would be expected, the highest metal concentrations per any particular waste were found in the most acid supernatant solutions. A comparison of all the acid solutions shows that four constituents are at relatively high levels compared to recommended water quality criteria for all the waste solutions. (The recommended water quality criteria were based on values for the most sensitive likely use of the water recommended by the U.S. EPA in 1972.) These four constituents were Al, total Fe (both Fe⁺² and Fe⁺³), Mn, and Zn. The range of concentrations of these constituents was 6 to 510, 2 to 3000, 1 to 31, and 0.3 to 110 mg/L respectively.

Attachment C

Site Name / TDD#: ALTA LE 8410-01
Case Number: 2569
Sampling Date: 1-10-85
Sampling Time: 1445 WEST
Sample/Station Location: -04101

Organic Traffic Number E A233
Inorganic Traffic Number ME B 484
High Hazard Traffic Number E

Physical Description

At time of collection: 10:30 - 11:00 A.M.
sandy brown

Physical Changes (if any)

From time of collection until shipment: _____

Instrument Readings (i.e. - pH, conductivity...): _____

TEMP = 10°C
CONDUCT
pH

Sampling Date: 1-10-85

Sampling Time: 1445

Sample/Station Location: 04103

n. woods
Organic Traffic Number E A 234
Inorganic Traffic Number ME B 485
High Hazard Traffic Number E

Physical Description

At time of collection: -10:30 - 11:00 A.M.

Physical Changes (if any)

From time of collection until shipment: _____

Instrument Readings (i.e. - pH, conductivity...): _____

TEMP = 10°C
CONDUCT =
pH = 4

EXECUTIVE SUMMARY

The City of Alton has operated a general disposal landfill at this site since about 1967. The landfill is located in a clay dig on the former Alton Brick Company site. IEPA files indicate that Alton Brick also operated a sub-surface coal mine on this location. In 1973 the air shaft of the abandoned mine was still open, but filled with what appeared to be leachate as per Attachment I.

There have been numerous citizen complaints alleging this landfill to be polluting Coal Branch Creek. At least one inspection, dated March 26, 1980, verified this to be the case.

The Alton Landfill has received no verifiable hazardous waste but has received large quantities of municipal sewage sludge. On several inspections it is noted that this sludge was in excess to the amounts of absorptive material being received as general garbage.

An inspection of September 9, 1980 placed the Alton Municipal Landfill on the Open Dump Inventory for Disease Vectors. Crows were witnessed feeding on uncovered material in the landfill.

The concern of this author toward this site would be the suspected reduction in ground water quality and the known leachate entry into surface water. A low priority has been assigned due to a lack of evidence associated with ground water interference and the none use of surface water in the area.

It would be recommended that the groundwater monitoring system be expanded and testing for priority pollutants be undertaken. The site history would also indicate an inspection for potential surface runoff of leachate.

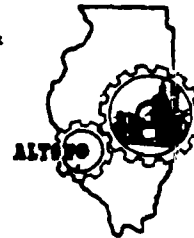
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Attachment E

JUN 24 1985

CITY OF ALTON, ILLINOIS

DEPARTMENT OF PUBLIC WORKS
CITY HALL ALTON, ILLINOIS



June 21, 1985

Ms Kelly Walker
Ecology & Environment
111 West Jackson Blvd, 8th Floor
Chicago, IL 60604

Dear Ms. Walker:

Enclosed per your request are Drilling Logs for the two monitoring wells at the Alton Sanitary Landfill. Monitoring Well No. 1 (IEPA Monitoring Point G101) is labeled MW-1 on the Well Installation Sketch. Monitoring Well No. 3 (IEPA Monitoring Point G103) is labeled B-1 on the Piezometer Sketch.

I could find no record of elevations on these wells.

Please contact me should you need further information.

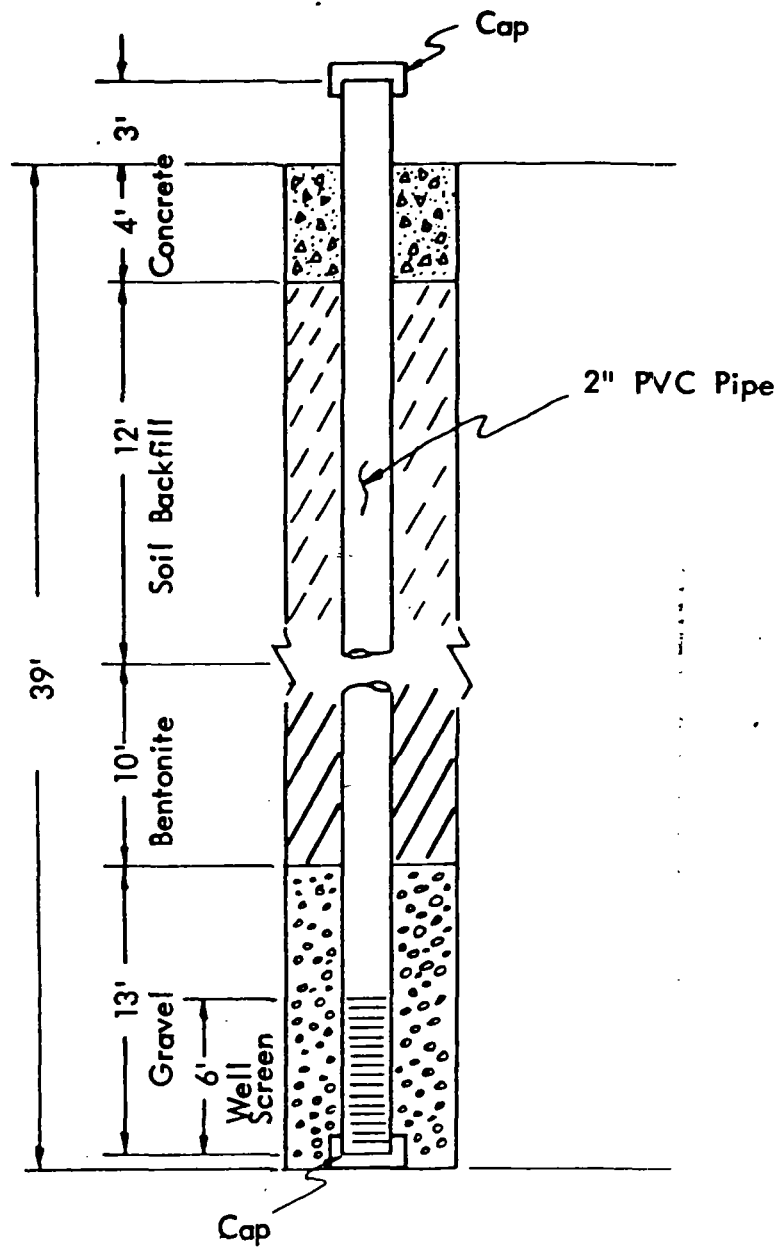
Very truly yours

A handwritten signature in dark ink, reading "Jerrold L. Olmstead". The signature is fluid and cursive, with a long horizontal stroke extending to the right.

Jerrold L. Olmstead
Superintendent
Alton Wastewater Treatment Plant

JLO/sck

Enc.



WELL INSTALLATION SKETCH

M W - 1
 Alton Landfill
 Alton, Illinois

RECORD OF SUBSURFACE EXPLORATION



BORING M W - 1 CONTRACT 387-77

DRILLED BY Gotsch DATE DRILLED 11/22/77 LOGGED BY Black
 PROJECT Aiton Landfill DRILLING METHOD Hand Auger Yes PIEZOMETER

DEPTH (FT.)	SAMPLE NUMBER	SAMPLE TYPE	NOTES	DESCRIPTION OF MATERIAL	BLOWS	DRY UNIT WEIGHT PCF	<div style="display: flex; justify-content: space-between;"> <div> <p>SHEAR STRENGTH, TSF</p> <p>0 0.5 1.0 1.5 2.0 2.5</p> </div> <div> <p>WATER CONTENT, %</p> <p>0 20 40 60 80 100</p> </div> </div>
				SURFACE ELEVATION			
				Br. Silty CLAY w/Roots, Top Soil			
5				Brown Silty CLAY			
10							
15							
20							
25							
30							
35				Brown Silty CLAY & CLAY w/Fine Sand			
				Cont'd			

GROUND WATER DEPTH AT COMPLETION _____ AFTER _____ HRS. AFTER _____ HRS.

SCALE 1" = 5'

JOHN MATHES & Associates

RECORD OF SUBSURFACE EXPLORATION



BORING M W - 1 CONTRACT 387-77

DRILLED BY Gotsch DATE DRILLED 11/22/77 LOGGED BY Black
 PROJECT Alton Landfill DRILLING METHOD Hollow Auger PIEZOMETER Yes

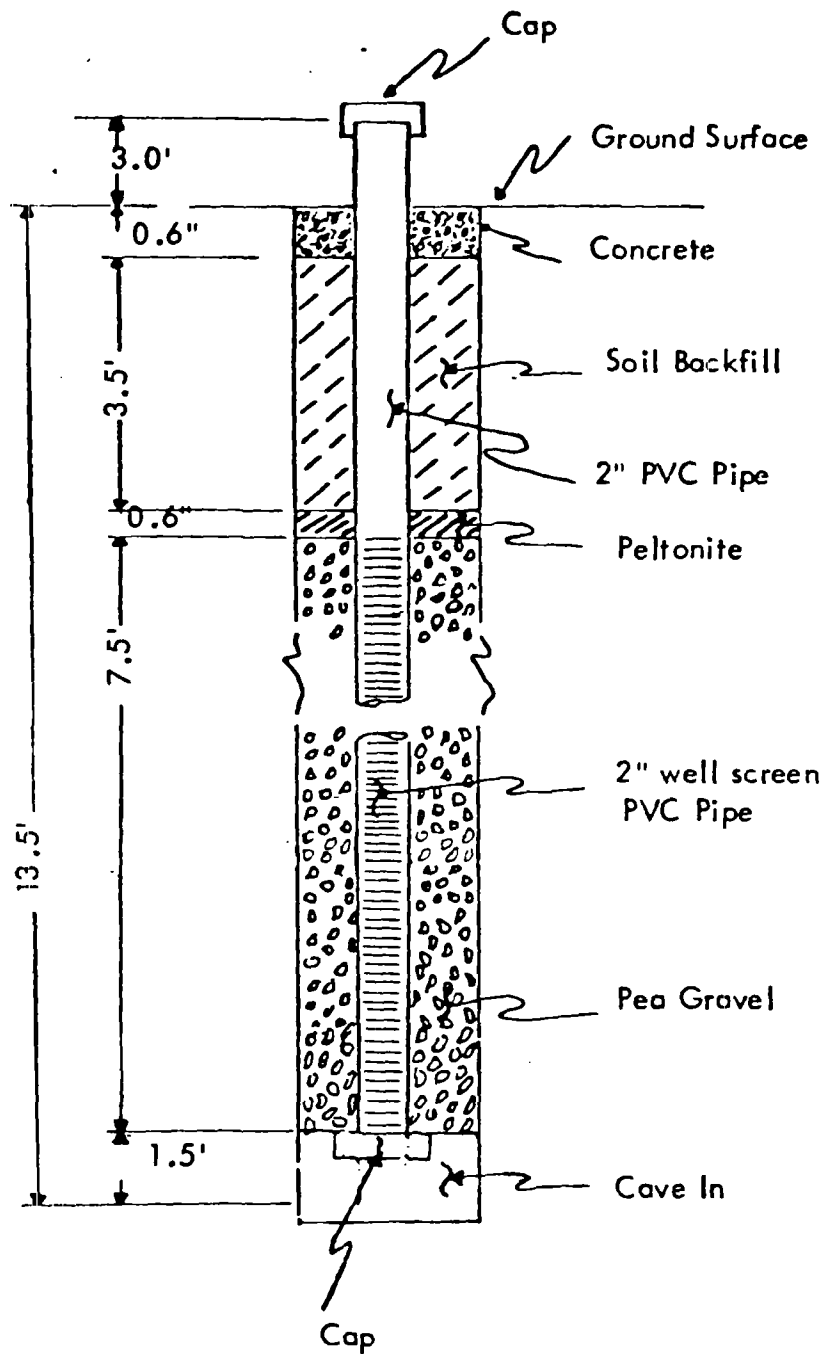
DEPTH (FT.)	SAMPLE NUMBER	SAMPLE TYPE	NOTES	DESCRIPTION OF MATERIAL	BLOWS	DRY UNIT WEIGHT PCF	<div> SHEAR STRENGTH, TSF Δ \square \circ 0 0.5 1.0 1.5 2.0 2.5 WATER CONTENT, % 0 20 40 60 80 100 </div>
40				Brown Silty CLAY & CLAY w/Fine Sand T. O. B.			

GROUND WATER DEPTH AT COMPLETION 29.1' AFTER 2 HRS. 27.3' AFTER _____ HRS.

SCALE 1" = 5'

JOHN MATHES & Associates

11-3



NOT TO SCALE

PIEZOMETER SKETCH
B-1 City of Alton Landfill Alton, IL

RECORD OF SUBSURFACE EXPLORATION



PROJECT City of Alton Landfill

BORING 1

City of Alton

DRILLED BY

LOGGED BY Simoncini

DATE DRILLED 10/11/79

PIEZOMETER Yes

CONTRACT 709-79

Auger

DRILLING METHOD

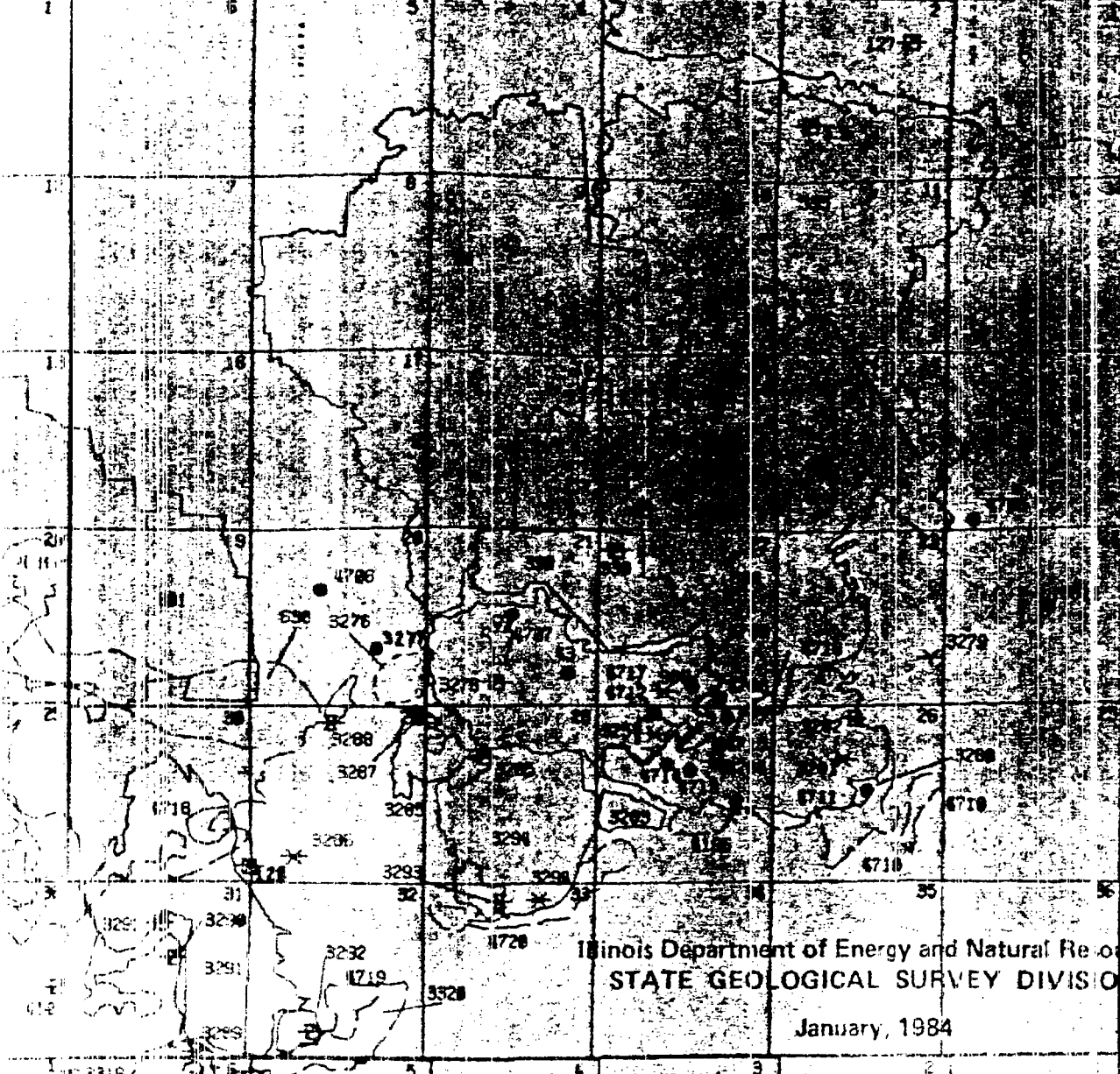
DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	NOTES	DESCRIPTION OF MATERIAL	BLOWS	DRY UNIT WEIGHT PCF	SHEAR STRENGTH, TSF SV L OP/2 OU/2 0 0.5 1.0 1.5 2.0 2.5	WATER CONTENT, % 0 20 40 60 80 100
				SURFACE ELEVATION _____				
	1	AU		Light Brown Sandy SILT w/traces of organic				
	2	AU		Dark Brown Silty CLAY w/traces of oxidized stains & fine sand				
	3	AU		Dk Bm Flakey SHALE & Silty CLAY				
	4	AU		Black Sandy, flakey SHALE				
	5	AU		COAL				
	6	AU		Gray Silty CLAY w/traces of fine Sand				
			Rock @ 13.5	A.R.				

GROUND WATER DEPTH AT COMPLETION _____ AFTER _____ AFTER _____

SCALE 1" = 5'

DIRECTORY OF COAL MINES IN ILLINOIS

Madison County



Illinois Department of Energy and Natural Resources
STATE GEOLOGICAL SURVEY DIVISION

January, 1984

Attachment F

- 4 -

ISGS INDEX	COMPANY NAME	MINE NAME	MINE NUMBER	MINE TYPE	YEARS OPERATED	COAL SEAM	TWP	RNG	SEC	LOCATION: QUARTERS
2814	RINK, ERNEST	RINK		SHAFT	1904-44	HERRIN NO. 6	6N	9W	13	SESWNW
2814	HAUCKE, HL			SHAFT	1905-44	HERRIN NO. 6	6N	9W	13	NENWSW
2804	CHALLENGORTH, AMOS (SPELLING?)			SHAFT	1879-01	HERRIN NO. 6	6N	9W	14	NWSFSW
2816	MCCREA, MINED BEFORE 1860	MCCREA			60	HERRIN NO. 6	6N	9W	14	SESWSW
2817	HENKHAUS, JOHN	HENKHAUS		SHAFT	1935-38	HERRIN NO. 6	6N	9W	14	NWSWSF
2818	SYCAMORE MINES	SYCAMORE			1935-36	HERRIN NO. 6	6N	9W	14	SWNWSW
6369	CHALLINGSWORTH		4				6N	9W	14	SWSWSW
2819	MUSSEL & MCCULLY C C	M & M			1934-35	HERRIN NO. 6	6N	9W	15	SESESE
2819	MUESSEL, JOHN	MUESSEL			1935-37	HERRIN NO. 6	6N	9W	15	SESESE
6510	LALLAM MINE OPER 1928						6N	9W	20	
6368	BURNS & CHALLINGSWORTH	MINES 1&4					6N	9W	22	SENESE
6505	MITCHELL & SONS MINE 2ND SH F3						6N	9W	22	SESWNE
2820	GOLIKE, HENRY	GOLIKE		SHAFT	1904-06	HERRIN NO. 6	6N	9W	23	SENWSE
2820	MYERS, H	MYERS		SHAFT	1904-07	HERRIN NO. 6	6N	9W	23	SENWSE
2821	BAUER, HENRY	BAUER		SHAFT	1915-18	HERRIN NO. 6	6N	9W	23	NWSWNW
2822	HILL, JAMES & CHALLENGORTH	H & C				HERRIN NO. 6	6N	9W	23	NWNWNE
2823	CULP GROVE C C	CULP GROVE		SHAFT	1928-38	HERRIN NO. 6	6N	9W	23	NENWNW
6371	OPER 1922			SHAFT			6N	9W	23	SWNESE
6513							6N	9W	23	NESWNW
2824	RUFF-SCHRAMMECK C C	R & S	1	SHAFT	1943-46	HERRIN NO. 6	6N	9W	25	SENESE
2824	ARDENT C C	ARDENT		SHAFT	1946-49	HERRIN NO. 6	6N	9W	25	SENESE
844	B & K C MNG C	B & K		SLOPE	59	HERRIN NO. 6	6N	9W	26	SWSESE
2825	SMITH, E L C C	SMITH		STRIP	1935-36	HERRIN NO. 6	6N	9W	26	NENWSW
2826	DRAPER-JOHNSON	D-J			1932-35	HERRIN NO. 6	6N	9W	26	NESWNW
6506							6N	9W	26	NWNWNW
2827	HANKHOUSE, J	HANKHOUSE		SHAFT	1884-85	HERRIN NO. 6	6N	9W	27	SESENE
2828	TICHNEAL, WM	TICHNEAL		SLOPE	1891-92	HERRIN NO. 6	6N	9W	27	SENESE
2829	HILL BROS	HILL BROS		SLOPE	1890-93	HERRIN NO. 6	6N	9W	27	SWNESE
2829	FRANKFORD, ANDREW	FRANKFORD		SHAFT	01	HERRIN NO. 6	6N	9W	27	SWNESE
2829	SCHRAM, FRANK	SCHRAM		SLOPE	1914-16	HERRIN NO. 6	6N	9W	27	SWNESE
2830	KOGEL & MITCHELL	K & M		SHAFT	1937-38	HERRIN NO. 6	6N	9W	30	SENWSE
6498							6N	9W	30	SWSWSE
6499							6N	9W	30	SESESW
6500							6N	9W	30	NWNESW
6589	OPER 1922			SHAFT			6N	9W	31	NESWNW
6540				DRIFT			6N	9W	35	NWNENE
2831	KOCH	KOCH				HERRIN NO. 6	6N	9W	36	SESESW
2832	PANAMA C C	PANAMA		SHAFT	1934-37	HERRIN NO. 6	6N	9W	36	SENWSE
2832	SCHONWEIS BROS	SCHONWEIS		SHAFT	1936-38	HERRIN NO. 6	6N	9W	36	SENWSE
2832	DALE, S M	PANAMA	1	SHAFT	1937-39	HERRIN NO. 6	6N	9W	36	SENWSE
2833	VALLEY C C	VALLEY			1931-32	HERRIN NO. 6	6N	9W	36	NENWSE
2834	BIG BEN C C	BIG BEN		STRIP	1933-34	HERRIN NO. 6	6N	9W	36	SENESE
2835	FRANKLIN, HOWARD C C	FRANKLIN		SHAFT	1931-34	HERRIN NO. 6	6N	9W	36	SWNWSW
3647	BEFORE 1929						6N	9W	36	NESESW
4253	VANDUKER (VAN DUKER)				1934-36	HERRIN NO. 6	6N	9W	36	SWNESE
6507							6N	9W	36	NENESW
6581	STARK SLOPE MINE BEFORE 1929			SLOPE		HERRIN NO. 6	6N	9W	36	NWSESE
6592				SLOPE			6N	9W	36	SENESE
2836	VANBERGER C C	VANBERGER			1934	COLCHESTER NO. 2	6N	10W	13	SESWSW
2837	GERDT C C	GERDT		SHAFT	1933-41	COLCHESTER NO. 2	6N	10W	24	NWNWNE
2837	GOACHER, EVERETT	GOACHER		SHAFT	1941-42	COLCHESTER NO. 2	6N	10W	24	NWNWNE
6501							6N	10W	24	NESESE
2838	RUTLEDGE, JOHN, OPEN BEF 75	RUTLEDGE			75	COLCHESTER NO. 2	6N	10W	35	NWSWSW
2839	WATTS, M M, OPER ART 1883	WATTS			1883-84	COLCHESTER NO. 2	6N	10W	35	NENENW
6488							6N	10W	35	SWNWSW
6489							6N	10W	35	NENWSW
6491							6N	10W	35	SWSWSW
6492							6N	10W	35	SWSWSE
6504	ALTON BRICK CO						6N	10W	35	SESENE
6535							6N	10W	35	NESWSW
283	ECCLES, BEN	ECCLES		SHAFT	1907-22	COLCHESTER NO. 2	6N	10W	36	SWSWSW
2840	KITTINGER, D M	KITTINGER				COLCHESTER NO. 2	6N	10W	36	SENESE
2841	BIG ARCH C C	BIG ARCH		SHAFT	1936-37	COLCHESTER NO. 2	6N	10W	36	SWSWNE
2842	WILSON, WARREN	WILSON			1933-39	COLCHESTER NO. 2	6N	10W	36	SESENE
6495							6N	10W	36	NWNWSW
6496							6N	10W	36	SWSWSW
6593	ZITTEL BEFORE 1922			SHAFT			6N	10W	36	NWSWSE
6594	BEFORE 1922			SHAFT			6N	10W	36	SENWNW
6595	BEFORE 1922			SHAFT			6N	10W	36	SWNENW
6596				SHAFT			6N	10W	36	SENESE

The Abundance of Zinc and Cadmium in Sphalerite-bearing Coals in Illinois



James C. Cobb
John D. Steele
Colin G. Treworgy
Jim F. Ashby

ILLINOIS MINERAL NOTE 74
March 1980
Urbana, IL 61801

ILLINOIS STATE GEOLOGICAL SURVEY
Division of Illinois Institute of Natural Resources
Jack A. Simon, Chief

The Abundance of Zinc and Cadmium in Sphalerite-bearing Coals in Illinois

James C. Cobb
John D. Steele
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ABSTRACT

Coals in four Illinois Counties (Fulton, Knox, Peoria, and Stark) are enriched in zinc and cadmium. These coals are the Danville (No. 7), Herrin (No. 6), Springfield (No. 5), and Colchester (No. 2) Coal Members. The zinc and cadmium enrichment is attributed to the presence of sphalerite, the principal ore mineral of zinc. The sphalerite is an epigenetic mineral occurring mainly as an open-space filling in fractures in the coals. This 4-county area contains approximately 7×10^9 tons (6.3×10^9 metric tons) of coal resources. The sphalerite, which is distributed in the coals, is a potential source for zinc and, to a lesser extent, cadmium as a by-product of the coal production.

Sphalerite was identified in the coal in fractures, cleats, tension gashes, shears, pyrite nodules, cell lumens of fusinite, and crystal aggregates in clastic dikes. Sphalerite was also observed in phosphate nodules in the black shales overlying some of the coals.

Five methods of sampling were used to determine zinc and cadmium concentrations in the coals. The sampling methods were bench, column, composite auger, composite face channel, and composite face grid. Large variability in the data from the five methods precluded their being distinguished from one another by the Student's *t* test. On the basis of minimum variance, the composite face grid sample was selected as the most appropriate method for sampling these coal seams for zinc and cadmium.

A strong positive correlation exists between high concentrations of zinc and cadmium and the degree of local structural disturbance of the coal. Disturbances in the seams include clastic dikes, faults, shears, and fractures, all of which may contain sphalerite.

Estimates of the potential tonnage of zinc in the coals of this area range from 3 to 14 million tons and for cadmium 30 to 100 thousand tons.